The Status of the Treaty to Ban TBT in Marine Antifouling Paints and Alternatives

Michael A. Champ[1]

Abstract

A new IMO convention was adopted on October 5, 2001, following a five-day Diplomatic Conference held at IMO Headquarters in London, will prohibit the use of harmful organotins in anti-fouling paints used on ships and establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.

THE TREATY

Treaty Specific Requirements:

Under the terms of the new Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard or offshore terminal of a Party.

Ships of above 400 gross tonnage and above engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate is issued for the first time; and a survey when the anti-fouling systems are changed or replaced.

Ships of 24 meters or more in length but less than 400 gross tonnage engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent. The Declaration will have to be accompanied by appropriate documentation such as a paint receipt or contractor invoice.

Anti-fouling systems to be prohibited or controlled will be listed in an annex (Annex 1) to the Convention, which will be updated as and when necessary.

As recommended by the 21st session of the IMO Assembly, the Conference agreed to an effective implementation date of 1 January 2003 for a ban on the application of organotin-based systems,

In November 1999, IMO adopted an Assembly resolution that called on the MEPC to develop an instrument, legally binding throughout the world, to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application of organotin compounds, which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition by 1 January 2008.

The new convention will enter into force 12 months after 25 States representing 25% of the world's merchant shipping tonnage have ratified it.

Annex I attached to the Convention and adopted by the Conference states that by an effective date of 1 January 2003, all ships shall not apply or re-apply organotins compounds which act as biocides in anti-fouling systems.

[1] President and CEO, The Advanced Technology Research Project (ATRP) Corporation. PO Box 2439, 7000 Vagabond Drive, Falls Church, Virginia, USA, 22042-3934, Tel (703) 237-0505, Fax (703) 241-1278. Published in the Proceedings of the 24th UJNR (US/Japan) Marine Facilities Panel Meeting in Hawaii, November 7-8, 2001.

By 1 January 2008 (effective date), ships either:

(1) shall not bear such compounds on their hulls or external parts or surfaces; or
(2) Shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

This applies to all ships (including fixed and floating platforms, floating storage units (FSUs), and Floating Production Storage and Offtake units (FPSOs).

The Convention includes a clause in Article 12 which states that a ship shall be entitled to compensation if it is unduly detained or delayed while undergoing inspection for possible violations of the Convention.

The Convention provides for the establishment of a "technical group", to include people with relevant expertise, to review proposals for other substances used in anti-fouling systems to be prohibited or restricted. Article 6 on Process for Proposing Amendments to controls on Anti-fouling systems sets out how the evaluation of an anti-fouling system should be carried out.

The Diplomatic Conference Adopted Four Resolutions:

Resolution 1. Early and Effective Application of the Convention - The resolution invites Member States of the Organization to do its utmost to prepare for implementing the Convention as a matter of urgency. It also urges the relevant industries to refrain from marketing, sale and application of the substances controlled by the Convention.

Resolution 2. Future work of the Organization pertaining to the Convention - The resolution invites IMO to develop guidelines for brief sampling of anti-fouling systems; guidelines for inspection of ships; and guidelines for surveys of ships. The guidelines are needed in order to ensure global and uniform application of the articles of the Convention, which require sampling, inspection and surveys.

Resolution 3. Approval and Test Methodologies for Anti-Fouling Systems on Ships - This resolution invites States to approve, register or license anti-fouling systems applied in their territories. It also urges States to continue the work, in appropriate international fora, for the harmonization of test methods and performance standards for anti-fouling systems containing biocides.

Resolution 4. Promotion of Technical Co-operation - The resolution requests IMO Member States, in co-operation with IMO, other interested States, competent international or regional organizations and industry programs, to promote and provide directly, or through IMO, support to States in particular developing States that request technical assistance for:

(a) the assessment of the implications of ratifying, accepting, approving, or acceding to and complying with the Convention;

(b) the development of national legislation to give effect to the Convention; and

(c) the introduction of other measures, including the training of personnel, for the effective implementation and enforcement of the Convention.

It also requests Member States, in co-operation with IMO, other interested States, competent international and regional organization and industry programs, to promote co-operation for scientific and technical research on the effects of anti-fouling systems as well as monitoring these effects.

ALTERNATIVES TO TBT

On April 4 & 5th at the Miami Convention Center, an International Symposium was held at Oceanology International, the Americas, 2001, focusing on Pollution Prevention from Ships and Shipyards and Antifouling Coatings. The Symposium held Special Sessions on:

- The status, science and engineering of advanced systems and technologies for the treatment of waste discharges from shipyards and drydocks;

- Treatment Systems and Advanced Technologies for Reducing or Processing Shipboard Operational Wastes and Discharges from Ships at Sea and for processing or treating these wastes at sea or ashore in Ports; and

- Alternative to TBT Marine Antifouling Systems and Technologies including specific focus on the science and technologies of existing systems such as Cu and as well as any new alternative marine antifouling coating systems and/or technologies and the use of Environmental Friendly Technologies (e.g., non-biocides).

This International Symposium was designed as a global forum to: (1) exchange data and information; (2) provide peer review results of different treatment systems; (3) present policy and regulatory strategies, and (4) publish papers in a special Edited Symposium Proceedings Volume.

Published Proceedings

Since 1986, a series of International Symposia have been organized to bring together research scientists, regulators, and policy and decision makers from academia, industry and government to provide a peer review and forum for R&D associated with antifouling paints, marine coatings, and pollution prevention from ship and shipyards. The earlier symposia (80's-90's) focussed primarily on organotin compounds (in particular TBT). Subsequent years have focused on treatment of wastes in shipyards from antifouling and marine coatings, and prevention of pollution from ships and shipyards. Over the years the following proceedings have been published:

Proceedings of the First International Organotin Symposium. The Oceans '86 Conference. Published by the Marine Technology Society and the Institute of Electrical and Electronics Engineers Council on Oceanic Engineering. Champ, M.A. (Symposium Chairman). 1986. The Marine Technology Society. Washington, D.C. Volume 3:1101-1330.

Proceedings of the Second International Organotin Symposium. The Oceans '87 Conference. Halifax, Nova Scotia, Canada. Published by the Marine Technology Society and the Institute of Electrical and Electronics Engineers Council on Oceanic Engineering. Champ, M.A. (Symposium Chairman). 1987. The Marine Technology Society. Washington, D.C. Volume 4:1296-1524.

Proceedings of the Third International Organotin Symposium. Held in Monaco. Published in the *Journal of Marine Environmental Research*. Champ, M.A. (Co-Chairman). 1990. Volume 23.

Proceedings of the Special Sessions. The Oceans '99 Conference, Seattle Washington, Sept 13-16, 1999. **Treatment of Regulated Discharges from Shipyards and Drydocks**. Champ, M.A., Fox, T.J., and A.J. Mearns (Editors). 1999. The Marine Technology Society. Washington, D.C. 20036. ISBN No. 0-933957-24-6. Volume 4. 223p.

Proceedings of the International Symposium for Pollution Prevention from Ships and Shipyards. April 4-5, 2001. Oceanology International 2001 Conference. Miami, Florida. Champ, M.A. (Chairman). This Volume.

Prevention of Pollution from Shipyards and Drydocks

At the Oceans '99 Conference a series of 6 sessions were held. The major focus of this Symposium was the "**Treatment of Regulated Discharges from Shipyards and Drydocks.**" Many of the papers presented were reviews of advanced technologies for the treatment of spent paint residues hydroblasted off ship bottoms and wastes from ships in shipyards. The proceedings included papers from special sessions on TBT organized by Dr. Alan Mearns from NOAA HAZMAT in Seattle. A total of 23 papers were published in the Proceedings, edited by Champ, Fox, and Mearns). 1999. The Marine Technology Society, Washington, D.C. 20036. ISBN No. 0-933957-24-6. Volume 4. 223p.

At IMO, the Marine Environmental Pollution Committee (MEPC - 43) had proposed an international ban on TBT with the date of January 1,

2003 as the last date to apply TBT on a vessels hull and January 1, 2008 as the date for TBT to be removed off all vessels. TBT is used by 70-80 percent of some 80,000 vessels in global trade. The shift in focus to waste treatment and waste treatment systems by the organizers of Oceans '99 was the first global attempt to bring together and review available technologies for the treatment of TBT and other biocides in washdown waters and wastewaters from marine antifouling coatings in shipyards and drydocks. The concern was that the rapidly advancing date of the IMO proposed ban on TBT would catch shipyards and drydocks without appropriate waste treatment technologies. Because after the IMO proposed Treaty to ban TBT is implemented in 2001, more TBT could be discharged as TBT contaminated hydroblasted wastewater (which is unregulated world wide, except in the State of Virginia) from shipyards and drydocks than has been leached while in ports and harbors from all of the ships using TBT over the last 40 years.

Draft Treaty to Ban TBT –
The Need for Alternatives

With the Draft Treaty at IMO being prepared to ban TBT in 2001, this Symposium in Miami at OI 2001 should have been a showcase and marketplace for new and alternative antifouling marine coatings to TBT. This did not occur. Companies with new alternative technologies (except for the few major established ones) declined to participate and did not present their alternatives to TBT and/or new products. Several rationales for this can be suggested:

- An early conclusion was that TBT dominated (70-80 percent) of the market and as such severely retarded the development of comparable alternatives because of the expense to develop and bring to market and register new antifouling paints (~ 10 million USD).

- Another was that most products were under some stage of development and testing and they were scrambling to be ready for the marketplace by 2003, so why present preliminary and incomplete information about new products?

- A third was that most of these technologies may have declined to participate for fear of being compared (as Not Comparable) to TBT and maybe the possibility of failing in this comparison (i.e., 3 years of protection compared to 5 years for TBT or other aspects of performance) and that this might impact (slow down or derail) the rapid drafting and processing of the Treaty by IMO (Oct.1-5, 2001 target date for the Diplomatic Conference) and/or subsequent ratification of the Treaty which would impact their competitiveness in the future marketplace. If TBT is banned and the only alternatives provide 3 years of protection, then the competition is between alternatives that provide 3 years of protection.

- It is also possible that many companies knowing that most of them were not registered in global markets at this time for one reason or another (high VOCs, trade barriers, etc) and decided to hold back and let the TBT ban be first implemented by IMO. Then it would be a lot easier for them to become registered (because regulators would have to expedite registrations and weaken requirements) and to enter the marketplace because of demand, without the presence of TBT, the marketplace and registration process is significantly changed because of market pull (demand) and need for products. [Sort of shift from buyers to sellers market].

- Also by not presenting their products at this Symposium, a products unknown status as a "comparable" available alternative to TBT then does not interfere or slow down the decision to ban TBT at IMO. This lack of valid comparable alternatives to TBT in the marketplace (by their lack of presentation at OI 2001) suggests that the IMO ban on TBT might be more a political decision than a scientific decision. The future may suggest that this ban was the mastermind of paint companies wanting to obtain greater market share (from TBT) and of paint companies that sell TBT based paints, realizing that if TBT is banned that they make more money selling alternatives to TBT marine coatings. For example, the alternatives to TBT all cost from 4 to 6 times more, making them more money (see Oceans 99 Proceedings, and Science of the Total Environment Special Issue). First, a 3-year paint has to be applied twice as often and costs 2 to 3 times as much (Damodaran, et al. 1999, and Champ, 2000).

ALTERNATIVES TO TBT

The Society of for Protective Coatings in the June 2000 issue of the Journal of Protective Coatings and Linings (Vol. 17(6):47-48, presented a sampling of what's available in Tin-Free Antifoulings in the *marketplace*. The summary is presented below as a

list of products available in the marketplace, it is not complete or comprehensive. Additional alternatives to TBT were discussed and presented at the Symposium, which were under development and or in testing, papers prepared for these products are included in the Proceedings.

The list published in JPCL is excerpted here below as a service to the community, since it is one of the first, such lists published. Available antifoulings fall into two basic types:

- Those with biocides other than tin, and
- Those without biocides.

The listed antifouling marine coatings contain either biocides, fouling-release products and/or non-biocides with self-polishing systems. The product information excerpted below was compiled by *PCE* from material provided by marine paint companies to the Journal. The list is not comprehensive but represents a significant range of products currently on the market. It was noted that some products have different names in different parts of the world. The list is excerpted here for informative purposes. Several papers were presented on some of these products at the Symposium, in addition, several papers were presented on non listed products (Cameron and Otto; Matias; and Alm).

TBT Free - With Other Biocide Additives Paint Systems:

- **Ameron ABC-3** coating releases cuprous oxide via hydrolysis, polishing the hull while the ship is underway, used in military, commercial and recreational vessels since 1983, and can be applied directly over most anti-corrosive primers, and is reported to be compatible with most existing antifoulings.

- **Chugoku Sea Grandprix 1000/2000** introduced in 1995 has patents in more than 20 countries is an hydrolysis-type product based on an organo-silyl acrylate polymers which has a booster biocide package for deep sea vessels, and is reported by Chugoku Marine Paints to provide fouling control from the polishing mechanism of the polymer for 5 years.

- **Chugoku Sea Grandprix 500/700** is a zinc acrylate-based hydrolysis type antifoulant with 500 for deep-sea vessels and 700 for coastal vessels. Chugoku Marine Paints reports that these coatings have been applied to over 3,000 ships providing 3 years protection and are suited for worldwide use.

- **Chugoku TFA 10** is an hydration-type antifouling for new construction that will be exposed to average fouling, and has been applied to more than 5,000 vessels in Japan and is known there as Marine Star 10.

- **Chugoku Sea Tender 10/12/15** is a hydration-type antifouling designed for deep sea vessels, Number 10 is a slow polishing and offers low biocide strength, 15 is medium polishing and offers medium or high biocide strength.

- **Hempel Globic** from Hempel Marine Paints achieves biocide release and polishing by an ion exchange mechanism with a matrix with inorganic fiber reinforcement for polishing and control and mechanical strength. Globic SP-ECO 81900 is for bottom and boot top of vessels in coastal trade at low to medium speeds in temperate or tropical waters, with a high polishing rate. Globic SP-ECO 81950 and 81920 are for deep-sea vessels operating at medium to high speeds and high activity, with low to medium polishing rates.

- **Hempel Olympic HI7661** is an ablative (hydration) antifouling bottom paint based on "vinylic" polymer with cuprous oxide and organic bioactive material, designed by Hempel Marine Paints to maintain a continually bioactive surface over its life span.

- **International Interclene 245** has been reported by International Coatings Ltd. to be an economical polishing controlled depletion polymer (hydration) system.

- **International Intersmooth Ecoloflex SPC** is a patented self-polishing copolymer technology developed by International Coatings Ltd. to provide controlled biocide release that is obtained by an hydrolysis mechanism based on a copper acrylate copolymer system with inherent self smoothing for extended in-service periods. Intersmooth Ecoflex 460/465 SPC is for deep-sea vessels, Intersmooth Ecoflex 360/365 SPC is for coastal vessels. Both products were developed with Nippon Paint Marine Coatings of Japan.

- **International Interspeed 340/640** are a polishing controlled depletion polymer antifouling marine coating. Interspeed 640 is a copper based marine coating available in North

America, and Interpseed 340 is based on copper and booster biocides is available in the rest of the world.

- **Jotun SeaQuantum** is a hydrolysis-type copper based antifoulant on a silyl polymer developed with Nippon Oil and Fats, a Japanese Company, reported by Jotun Paints to provide up to 5 years of protection. Three paints are available: SeaQuantum Plus for vessels (operating > 18 knots), SeaQuantum Classic (12-20 knots), and SeaQuantum FB for flat bottoms of vessels.

- **Jotun Sea Queen** is a new and advanced self-polishing paint reported by Jotun Paints to be based on an hydration mechanism with new raw materials and active ingredients to provide up to 3 years of protection.

- **Jotun Sea Prince** is a self-polishing hydration product reported by Jotun Paints designed for economy and performance with up to 30 months of protection (36 months on flat bottoms).

- **Jotun Sea Gurdian** is a hydration type self-polishing system by Jotun Paints reported to be for maintenance and repair work for vessels interested in 3-year drydocking intervals. In the US, the product is sold as **Hydroclean 60A 1000**.

- **Kansai Exion** is a self polishing antifouling paint based on an ion exchange reaction of a zinc acrylate polymer designed for ocean going vessels reported by Kansai Paint to provide protection for 3 or more years.

- **Kansai Captain A/F/ Exion**. Similar to the above, except designed for coastal vessels.

- **Kansai Nu Crest** is a hydration-type antifoulant reported by Kansai Paint to protect all vessel types for up to 3 years.

- **Leigh's Envoy TF 500/600** from Liegh's Paints are reported to be ablative antifoulings based on high-performance polymeric resins, with TF 600 being free of copper as well as tin.

- **Leigh's Grassline Exion TF 700/701** are new products based on an ion exchange polishing mechanism, with TF 701 being a fast-eroding paints, both are in patch trials.

- **Sigma Alphagen** is a new patented polymer paint reported by Sigma Coatings to last 5 years, it is based on a pure organic binder developed by Sigma in cooperation with TotalFina-Elf Laboratories which releases cuprous oxide and organic co-biocides for up to 36 months. Alphagen 50 is a high-activity, fast polishing paint for coastal vessels, Alphagen 20 is a medium polishing for deep-sea vessels, and Alphagen 10 is for flat bottoms of vessels.

- **Sigma Sigmaplane Ecol** is a hydration-type antifouling containing cuprous oxide and is reported by Sigma Coatings to provide 36 months of protection.

- **Transocean Marine Paint Association Cleanship** represents various small paint manufactures and markets four products: Cleanship 2.91 for medium to fast-speed vessels, Cleanship 2.93 for medium-speed vessels, Cleanship 2.95 for slow-to medium-speed vessels, and Cleanship 2.97 for slow-speed vessels (36 months of protection). Two coatings of the first three products are reported by the Association to provide up to 40 months of protection.

- **Transocean Marine Paint Association Optima** has four versions of this ablative paint available Optima 2.30 (for up to 8 months dry-docking intervals), Optima 2.32 (for 12 months protection), Optima 2.34 (for 18 months protection), and Optima 2.36 (for 18 months protection).

TBT Free and Biocide-Free Systems:

These marine antifouling-coating systems do not contain organotins (TBT) or other biocides (copper, zinc, etc.) as additives to the paint antifouling system. Many delegations at MEPC (43-46) feel that the ultimate purpose of the IMO Treaty for the ban of harmful antifouling marine coating should be biocide free antifouling marine coating systems for ships to provide greater protection to the marine environment. The following biocide (toxin) free marine coatings have been developed and/or under development.

- **Aegis SeaPoxy** is a single-component, water-borne, polysiloxane epoxy fouling-release coating from Aegis Coating Technologies reported for use on steel, aluminum, or non-metallic surfaces or either slow-or fast moving vessels.

- **Chugoku Seajet 2000** is a silicone-based product from Chugoku Marine Paints is reported to be designed for fast ferries and naval vessels.

- **Hempel Hempasil SP-EED 77100 (and SP-EED Tie Coat 27301)** is a silicone-based fouling release coating that cures upon exposure to moisture in air is reported by Hempel Paints to be designed as a bottom paint for medium- to high-speed vessels with short idle periods.

- **International Intersleek** from International Coatings Ltd. is two products: Intersleek 425 (for 30 knots) and Intersleek 700 (for high activity, deep sea 15-30 knots) is reported by International Coatings Ltd. to last 5 years (two coatings).

- **Kansai Captain Biox** is a fouling release products based on silicone resins reported by Kansai to present a uniform and smooth surface of low energy that deters attachment for coastal and low-speed vessels.

- **Leigh's Biogard** is a low surface energy antifouling coating reported by Leigh's to present a uniform and smooth surface of low energy that deters attachment.

- **Sigma Sigmaglide** is reported to be a two-coat fouling-release system from Sigma Coatings. It requires Sigmaglide Tiecoat, a two-component silicone coating to aid adhesion of the system to a specific epoxy anti-corrosion system, plus Sigmaglide Finish.

- **Transocean Marine Paint Association Ultima** is reported to be a silicone-based system consisting of Ultima Tiecoat 95.50 and Ultima Topcoat 95.55.

- **Transocean Marine Paint Association Futureline 95.60** is reported to be a silicone-free system that operates by surface repellents and polishing.

REFERENCES

Champ, Michael A. and Peter F. Seligman. (Editors). 1997. Organotin: Environmental Fate and Effects. Chapman & Hall Publishers (U.K.). 29 Chapters. 664p.

Treatment of Regulated Discharges from Shipyards and Drydocks. 1999. Proceedings of the Special Sessions held at Oceans '99 in Seattle Washington, Sept 13-16, 1999. (Champ, Fox, and Mearns, Editors). The Marine Technology Society, Washington, D.C. 20036. ISBN No. 0-933957-24-6. Available on CD-Rom or PDF format by E-mail from: www.atrp.com. Volume 4. 223p.

Champ, Michael A. 2000. A Review of Organotin Regulatory Strategies: Pending Actions, Related Costs and Benefits. *Science and the Total Environment*. Volume 258(1):21-71.

Pollution Prevention from Ships and Shipyards. 2001. Oceanology International 2001 Symposium. (Champ, Chairman and Editor). April 4-5, 2001. Miami, Florida. Office of Naval Research. Proceedings available on CD-Rom or PDF format by E-mail from: www.atrp.com. Volume No. (1). 250p.

Damodaran, Nimmi, John Toll, Mike Pendleton, Conrad Mulligan, David DeForest, Michael Kluck, Mary Sue Brancato and John Felmy. 1999. Cost Analysis of TBT Self-Polishing Copolymer Paints and Tin-Free Alternatives for Use on Deep-sea Vessels. *In*: Proceedings of the International Symposium on the Treatment of Regulated Discharges from Shipyards and Drydocks. (Champ, Fox, Mearns, Editors). ISBN Number 0-933957-24-6. Vol. 4: 153-168.